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EFFECT OF IMMOBILIZATION ON THE EEG OF THE BABOON. COMPARISON  
WITH TELEMETRY RESULTS FROM UNRESTRICTED ANIMALS

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16. Abstract The EEG of the baboon was studied under two very different sets of conditions: 37 were totally immobilized while 12 were studied in their free movements with 4 channel telemetry. For the immobilized, 3 stages were described: I - activation, record desynchronized; II - rest with 13-15 cm/sec rhythm, like the human alpha rhythm stage but with eyes open or closed; III - "relaxation" with a decrease in 13-15 rhythm and the appearance of 5-7 cm/sec theta waves, eyelids closed, animal apparently sleeping. For the free animals the rest stage appeared when the animal's attention was not directed anywhere and there was no "relaxation" stage. There is an exact and constant sequence taking the animal from the rest stage with eyes closed to sleep. The "relaxation" stage succeeds the rest stage without an intermediary stage of fundamental rhythm reinforcement. In the "relaxation" stage the theta waves are more abundant and occur in bursts more so than in sleep. This stage may be compared with states of so-called animal hypnosis and is a special functional state to be clearly distinguished from the physiological stages of sleep.			
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EFFECT OF IMMOBILIZATION ON THE EEG OF THE BABOON. COMPARISON WITH TELEMETRY  
RESULTS FROM UNRESTRICTED ANIMALS

J. Bert and H. Collomb

The electroencephalogram (EEG) of the baboon (*Papio papio*) was studied under two very different sets of conditions. Recordings were made of 37 monkeys totally immobilized in an immobilization chair, while 12 others were studied during unrestricted movement by means of a four channel telemetry system (manufactured by Alvar Electronic). One channel was used for transmitting ocular movements, two for the EEG (fronto-central lead, parieto-occipital lead) and the fourth for a myogram of the muscles of the nape of the neck. /1202\*

Results

/1203

1. For the immobilized animal three stages were described<sup>1</sup>. The first stage is one of activation with complete desynchronization of the record. The second is a state of rest characterized by the presence of a 13-15 cm/sec rhythm, more or less ample, that predominated at times in the occipital region but more frequently in the central region, a stage that corresponds to the human alpha rhythm stage but is observed with the eyes open as well as closed. The third stage is one of "relaxation" with a decrease in the 13-15 rhythm and the appearance of theta waves at 5-7 cm/sec. The eyelids are closed and the animal seems to be sleeping. During the recording this stage showed up for the first time only after a state of rest that was sometimes very brief. However this sequence was not necessarily maintained. When the animal opened its eyes the record was desynchronized (activation stage). The "relaxation" stage returned immediately upon the eyes being closed without an intervening stage of rest.

2. In the case of animals whose mobility was unrestricted the activation stage was observed at the time of affective manifestations and more generally when vision was localized (for example when the animal was picking up a grain of rice from the ground). The rest stage appeared at the times when the animal's attention was not directed anywhere, even though the eyes remained open. One noticed slight changes

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\*Numbers in the margin indicate pagination in the foreign text.

in the amount and rate of the fundamental rhythm following attention lapses.

During the hot hours of the day the animal would take short naps (stage I in the laboratory classification). This stage I had two subdivisions: first a reinforcement of the fundamental rhythm (stage Ia) which was rather short; then disappearance of the fundamental rhythm with appearance of theta waves (stage Ib).

#### Discussion

A comparison of the EEG of an immobilized baboon and one at liberty shows a distinct difference in respect to the "relaxation" stage. In the free state the animal shows no such stage. It clearly distinguishes the waking (stages of activation and repose) and sleeping recordings.

There is an exact and constant sequence that takes the animal from the closed eyes rest stage to sleep (stages Ia, then Ib). During recordings made during the night continuously, some animals did not sleep. All night long the animal's record was that of rest and infrared observation indicated that the animal was indeed in a sleeping position with closed eyelids.

Obviously there is a similarity between this "relaxation" stage and stage Ib, but there are also marked differences. The "relaxation" stage succeeds the rest stage without an intermediary stage Ia of fundamental rhythm reinforcement. In fact this stage may come immediately after an activation stage, something never observed during sleep. Thus each time the animal falls asleep one notes this sequence: rest stage, stage Ia - Ib, even if this sequence occupies a very short time (for example 40-60 seconds).

Moreover, from the morphological point of view the "relaxation" stage has features that distinguish it further from stage Ib. The theta waves are more abundant /1204 and occur in bursts more so than in sleep.

Thus the "relaxation" stage appears to be a stage of decreased wakefulness that is quite close and yet distinct in respect to the first stage of physiological sleep. It may be admitted that it has a special functional significance. It may be compared with states that have been termed animal hypnosis <sup>2</sup>. The association of intense fear and forced immobilization is particularly effective in producing this hypnosis. They

also happen to be the conditions in which the recording was done. Neither fear nor immobility produce the appearance of this state of "relaxation" but immobilization does. These hypnotic states have been the subject of numerous works but no clear explanation of them has been offered. It is difficult to separate precisely the respective influence of these two factors, emotional and somesthetic, to which the phenomenon is attributed.

One piece of data perhaps may be presented with assurance. The EEG pattern of the immobilized animal that has been described as the "relaxation" stage represents a special functional state which one must distinguish clearly from the physiological stages of sleep.

Footnotes

1. J. Bert and H. Collomb, Electroenceph. clin. Neurophysiol. [Electroencephalography in Clinical Neurophysiology], 1964, Vol. 17, p. 545.
2. I. Oswald, Sleeping and Waking, Elsevier, Amsterdam, 1962, p. 232.